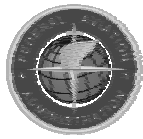
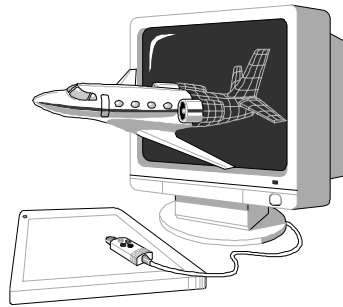


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User Modifiable Software



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Software Standardization Conference
May 15, 2002

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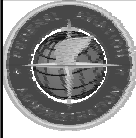
Purpose

- Guidelines to ASEs & DERs for Approval of Systems with User-Modifiable Software (UMS)

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History

- N8110.84 (1999) -> N8110.94 -> (2001) -> O8110.SW (200?)
- Earlier Versions of DO-178 Contain No Guidance for User-Modifiable Software
- Use DO-178B Guidance for The User-Modifiable Portions

3



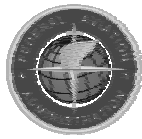
DO-178B References to UMS

- **Sections 2.0 & 2.4a.-d.**
 - System Design
- **Sections 5.2.3 & 7.2.2.b.**
 - Software Process
- **Sections 11.1g., 11.10g., 11.20g.**
 - Software Data

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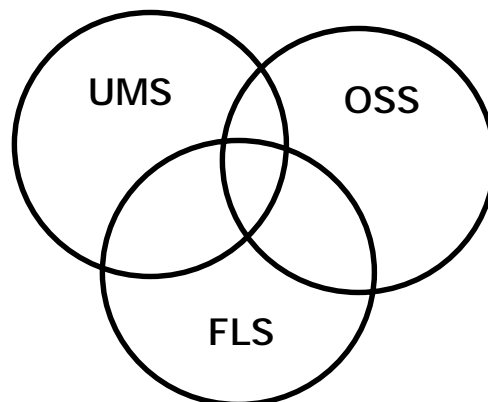
Definitions

User-Modifiable Software	Software intended for modification by the airplane operator without review by the certification authority, airframer, or equipment manufacturer.
Option-Selectable Software	Software that contains approved and validated components that may be activated by the user.
Field-Loadable Software	Software that can be loaded without removal of the equipment from the aircraft installation.

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Definitions



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Databases, etc?

- What About Navigation or Terrain Databases?
- What About Programmable Waypoints or Other Programmable Database-Like Items?

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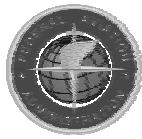
Order 8110.SW Chapter 7

- Safety Considerations
- Displayed Data
- Performance Parameters
- Protection
- Tools
- Data Requirements
- Other Considerations

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Safety Considerations (Biggest Concerns)

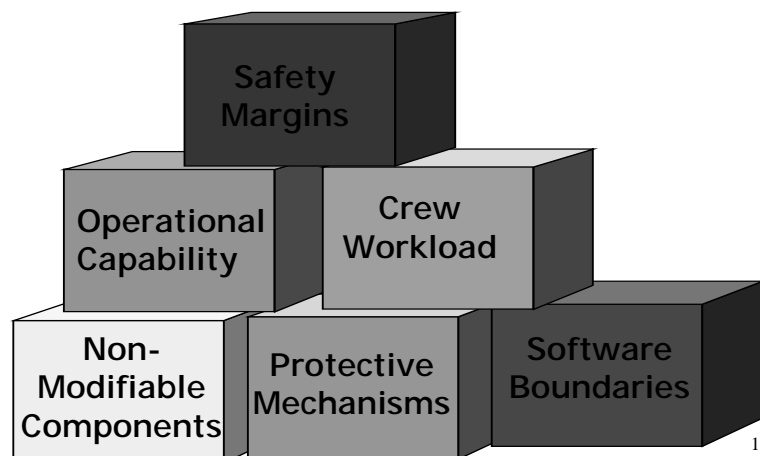
- ✖ Corruption of Non-modifiable, Safety-related Software
- ✖ Change Control Problems in the Field
- ✖ Compelling but Invalid Information in the Cockpit

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Safety Considerations


Modifications Should Have No Effect On



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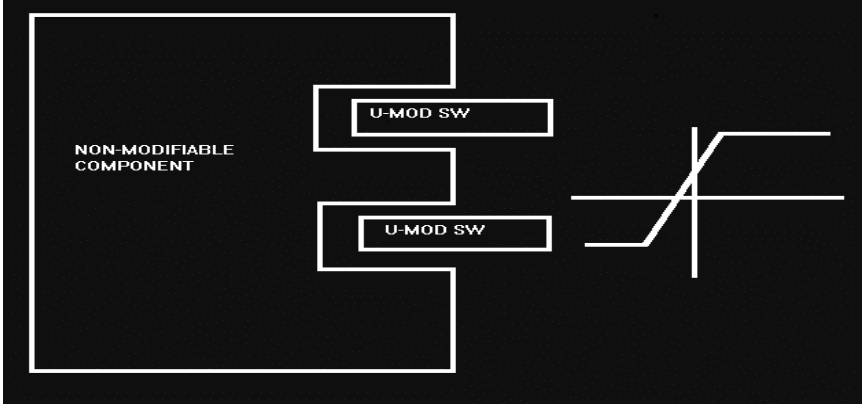
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Safety Considerations

- Effects Must Be Bounded



The diagram illustrates a system architecture where a 'NON-MODIFIABLE COMPONENT' is connected to two 'U-MOD SW' (User Modifiable Software) blocks. These blocks are connected to a graph showing a bounded effect, represented by a line that starts at a low level, rises sharply, and then levels off at a high level, indicating that the effects of the U-MOD SW are bounded.

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Safety Considerations

- Once Certified as UMS There is No Certification Authority Oversight



The illustration shows a person in a suit holding a magnifying glass, symbolizing oversight or inspection. This figure is enclosed in a circle with a large 'X' over it, indicating that once software is certified as UMS, there is no further oversight from the Certification Authority.

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Displayed Data



- Obvious or Explicit Indication That the Data is Not Cert Authority Approved

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Order 8110.SW

Chapter 7

- Safety Considerations
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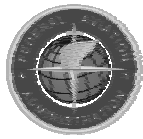
Performance Parameters

- Modifications to Provide or Revise Performance Parameters Requires Certification Authority Review and Approval
- Examples of Parameters
 - Safety margins
 - Operational capabilities
 - Crew workload

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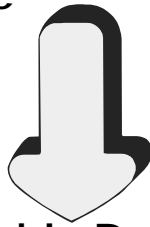
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Performance Parameters

- Changing Data To Determine Aircraft Performance Parameters = Major Change



- User-Modifiable Designation Lost

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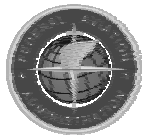
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Protection

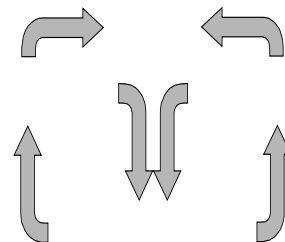
- UMS Components Shouldn't Affect Non-UMS Components
- Assure Protection Is Developed to at Least Same Level of Robustness Required of the Most Robust Non-UMS Component

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Protection

- Two Considerations
 - Operating In:
 - Protection in the design and operation
 - Changing Out:
 - Protection during modification



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Protection

- Examples
 - Partitioning
 - Hardware Modes
 - Encoding
 - Tools
 - Modifications
 - Loading Protection (CRC)

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Protection



Protect Against
Breaches

- Accidental Breach
 - Low Likelihood Under Reasonably Probable Circumstances
 - (Subjective statement of probability - not a xx.1309 definition)
- Intentional Breach
 - Low Likelihood Without Undue Effort

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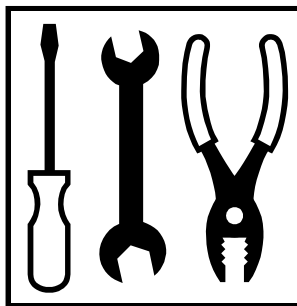
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Tools



- **Used to Enforce Protection**
 - Not DO-178B Qualified Tools?
- **Demonstrated As the Only Means To Modify UMS Component**

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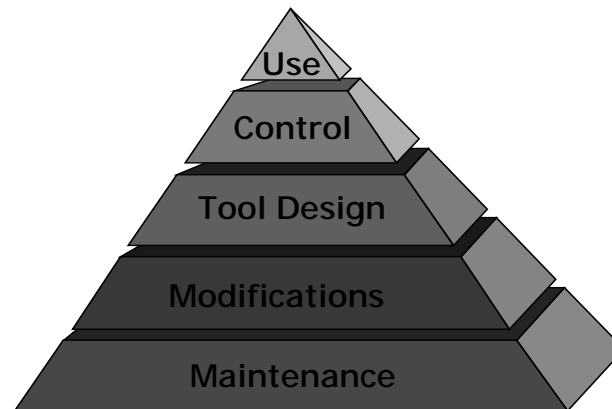
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Tools

Requires Review and Approval Of:



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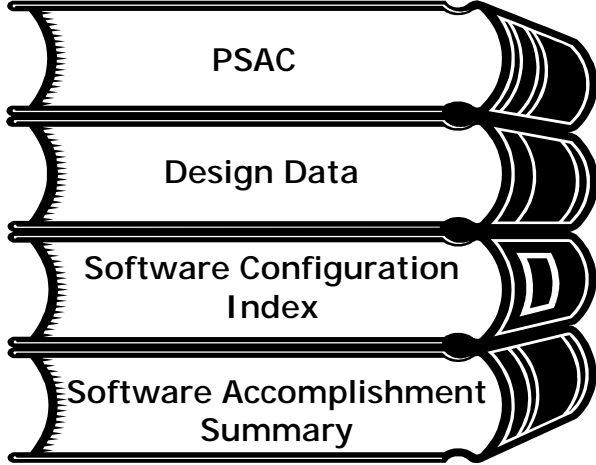
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Data Requirements




PSAC

Design Data

Software Configuration Index

Software Accomplishment Summary

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Other Considerations

- **User Follows the Approved Procedures for Modifications to UMS**
- **User Responsible for Configuration Management, Quality Assurance, and Verification of the Software**
- **Changing Anything Besides UMS Can Result in Certificate Being Rescinded**

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